Predicting Zoonotic Hemorrhagic Fever Events in Sub-Saharan Africa using NASA Earth Science Data for DoD - Global Emerging Infections Surveillance and Response System

PI & Co-I's:

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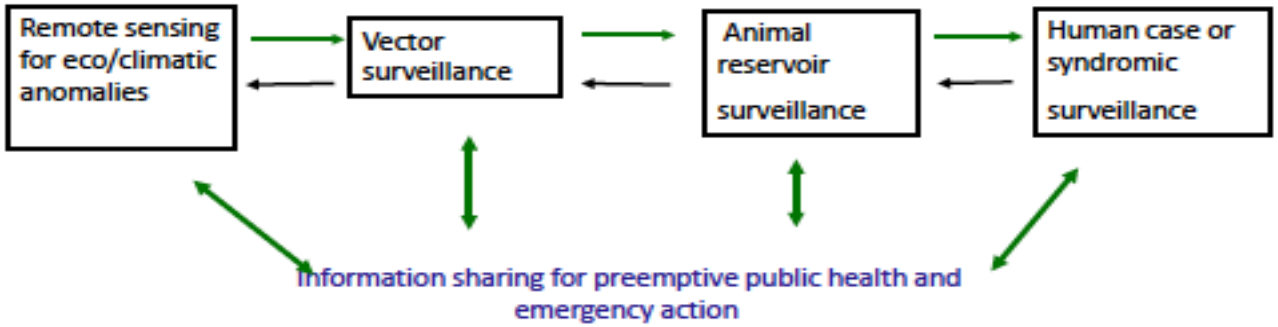
Goals
Zoonotic Hemorrhagic Fever Events in Sub-Saharan Africa

- Enhance and strengthen DoD-GEIS efforts to build a sustainable global capacity for surveillance and response to emerging zoonoses.



- Contribute to the development and interoperability of more international surveillance networking, complementing existing international (WHO, FAO) and national surveillance systems with early warning capabilities developed from integrated NASA Earth science data and models.
- Refine the early warning models for Rift Valley Fever (RVF), and Marburg/Ebola Hemorrhagic Fever (MHF/EHF) filoviruses with multi-level monthly risk maps.
- Prototype the development and production of a climate quality data record (NDVI-rainfall) to ensure data continuity in DoD-GEIS early warning system.

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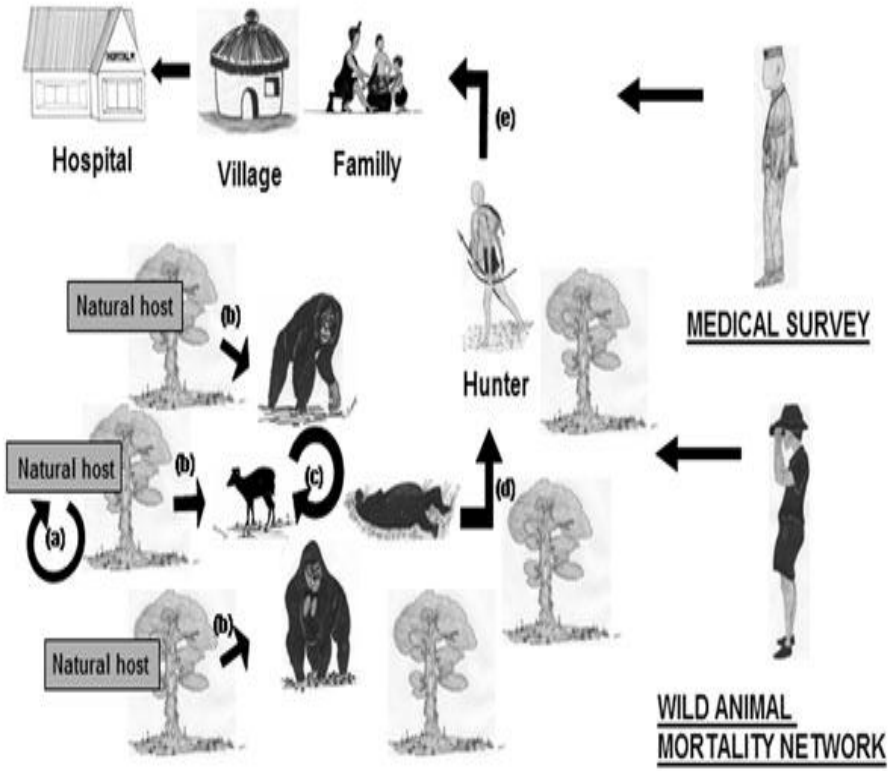
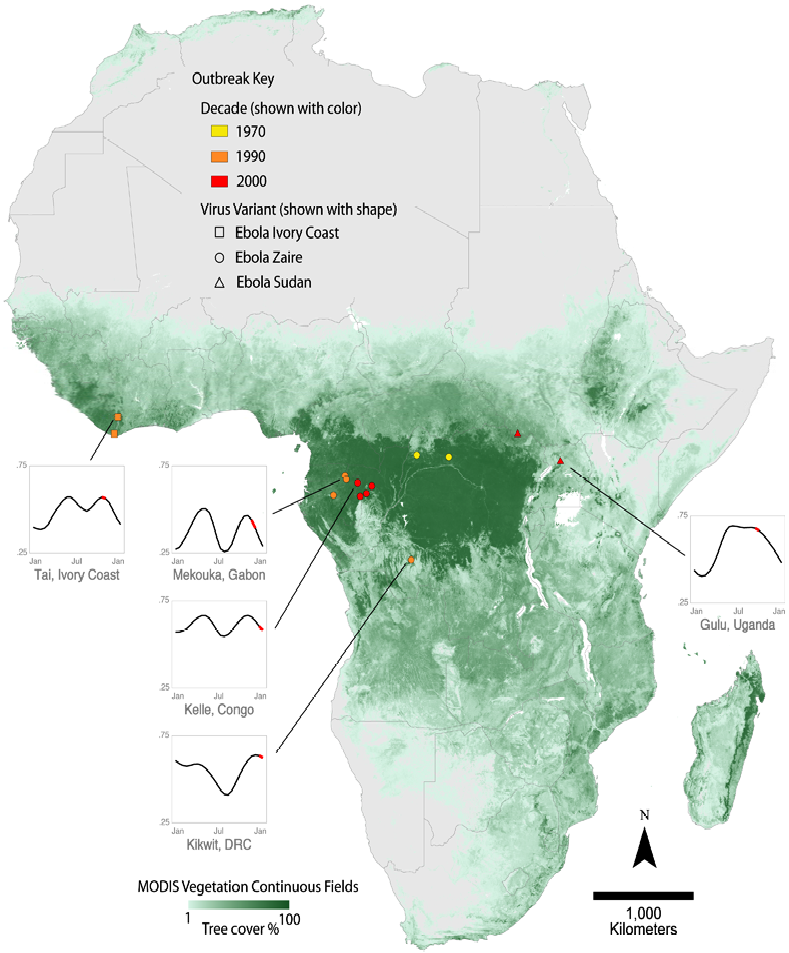
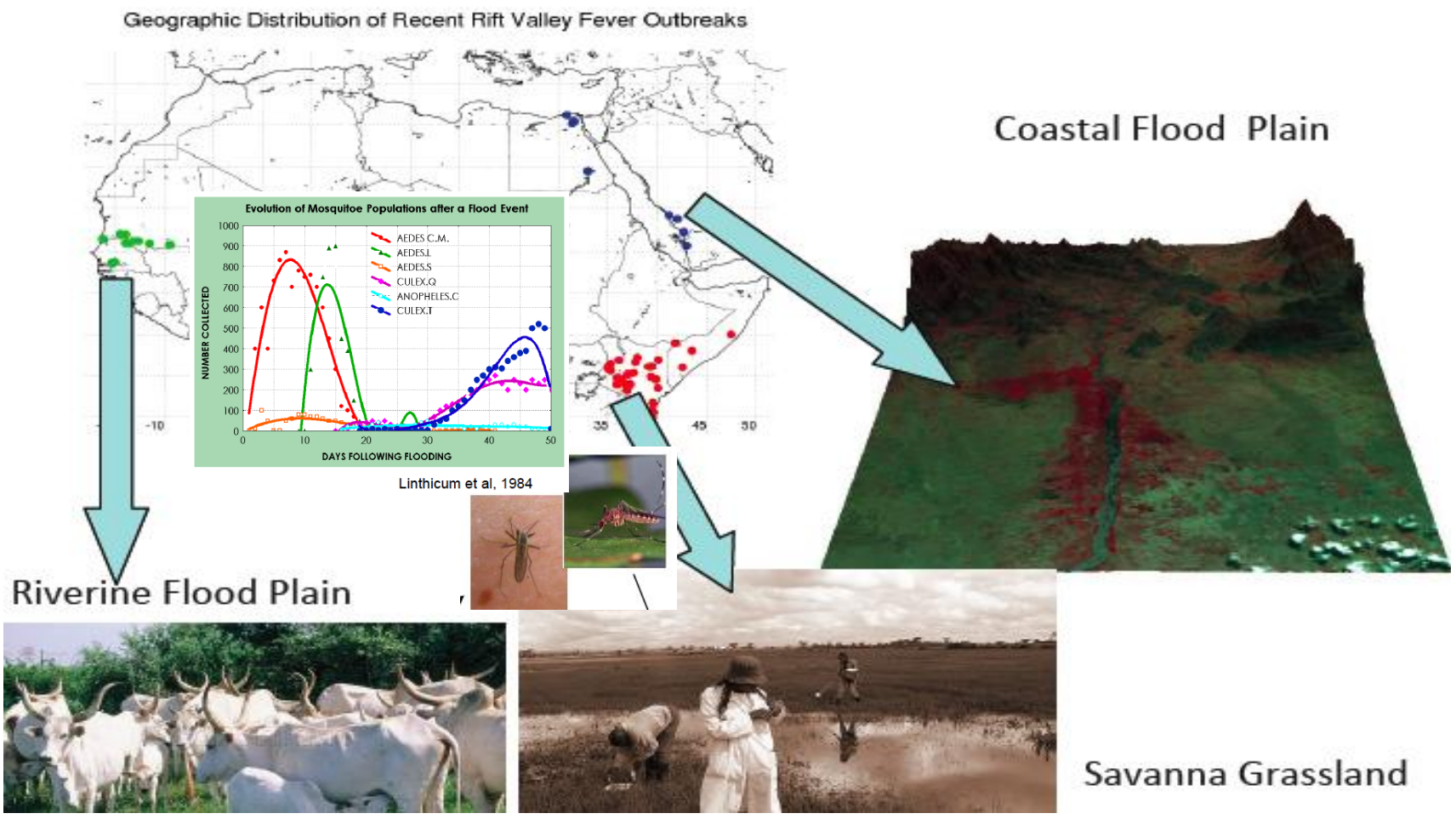
Background – Ebola/Marburg



Ebola Cycle: Rouquet et al. EID 2005



Background - RVF



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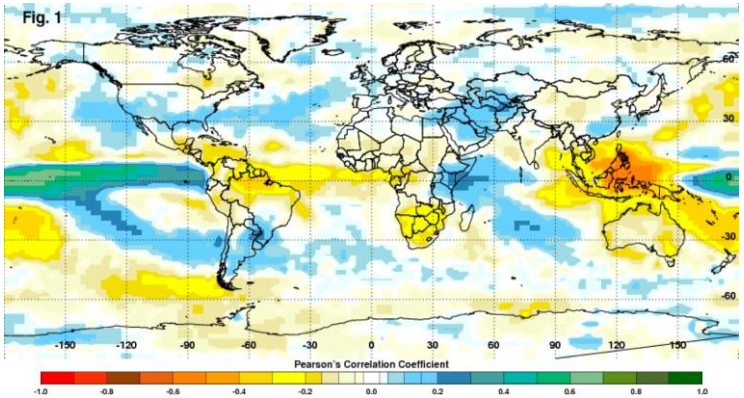
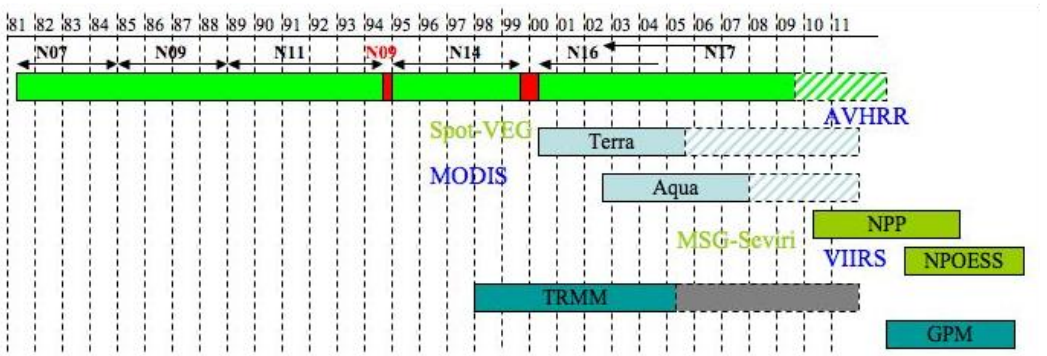
Model Inputs

Correlation ENSO & Ecological Dynamics





Inputs	Current Sensor/Data	Operating intermediate data	Extended long-term monitoring
Climate time series El Niño-Southern Oscillation(ENSO) North-Atlantic Oscillation (NAO)	Sea Surface Temperature (SST) From NOAA(monthly update)	N/A	
Disease&Vector Data	Latitude&Longitude&Date		
Imagery time series Precipitation (PPTN) Normalized Difference Vegetation Index (NDVI) NDVI / Temperature	TRMM - monthly update AVHRR - biweekly or as needed MODIS - monthly	MeteoSat SPOT MODIS	GPM / Jul 2013 NPP-VIIRS Jun 2011

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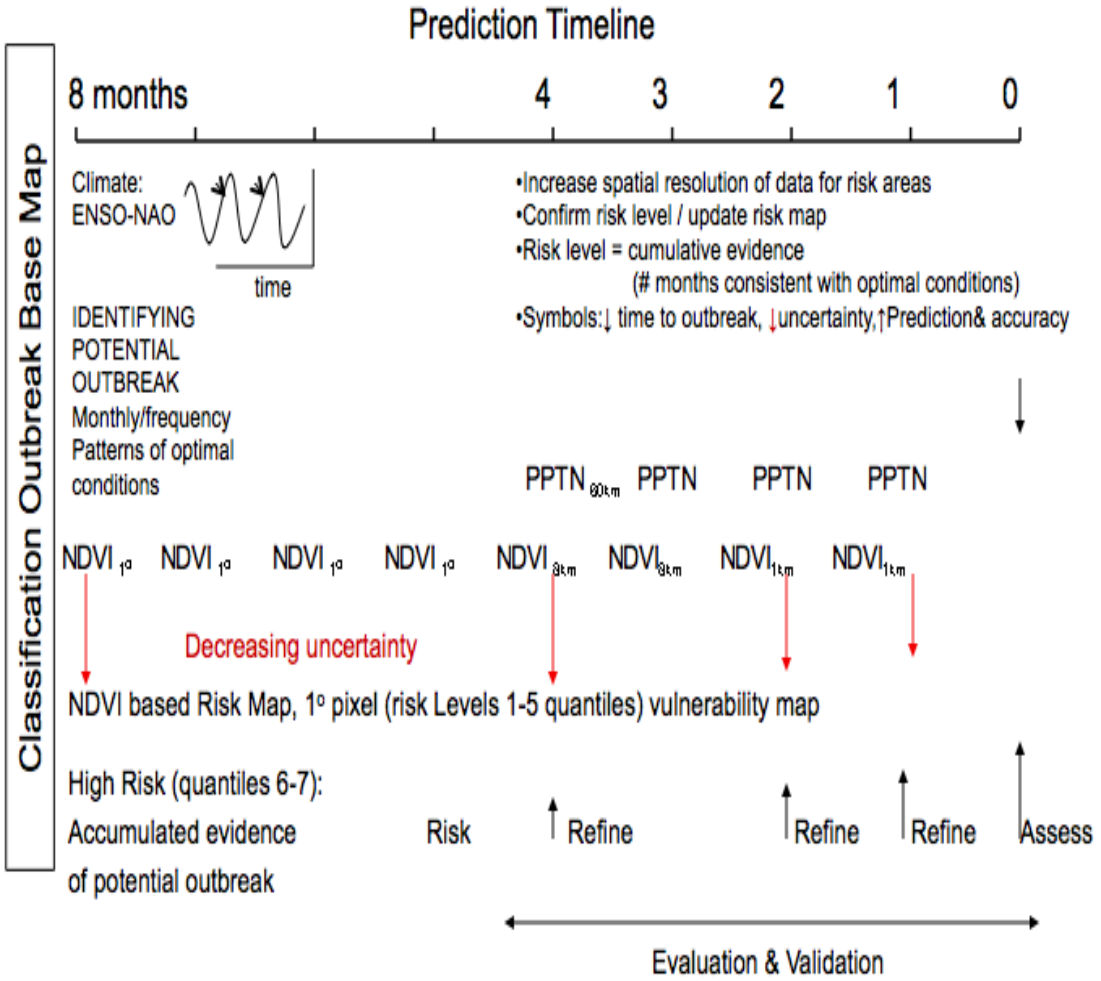
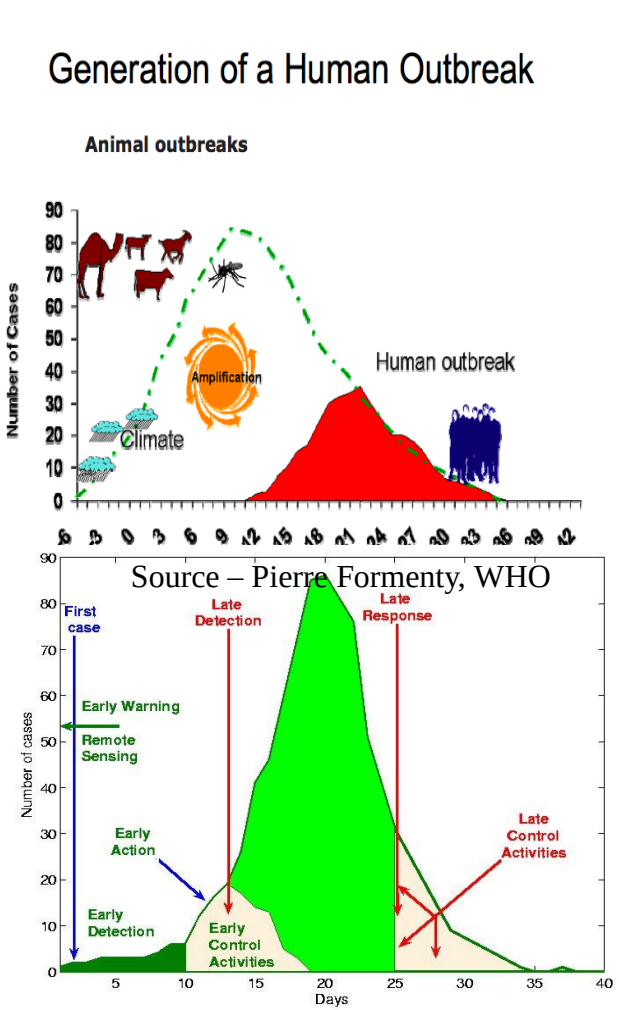
Prediction Framework





Source – Pierre Formenty, WHO

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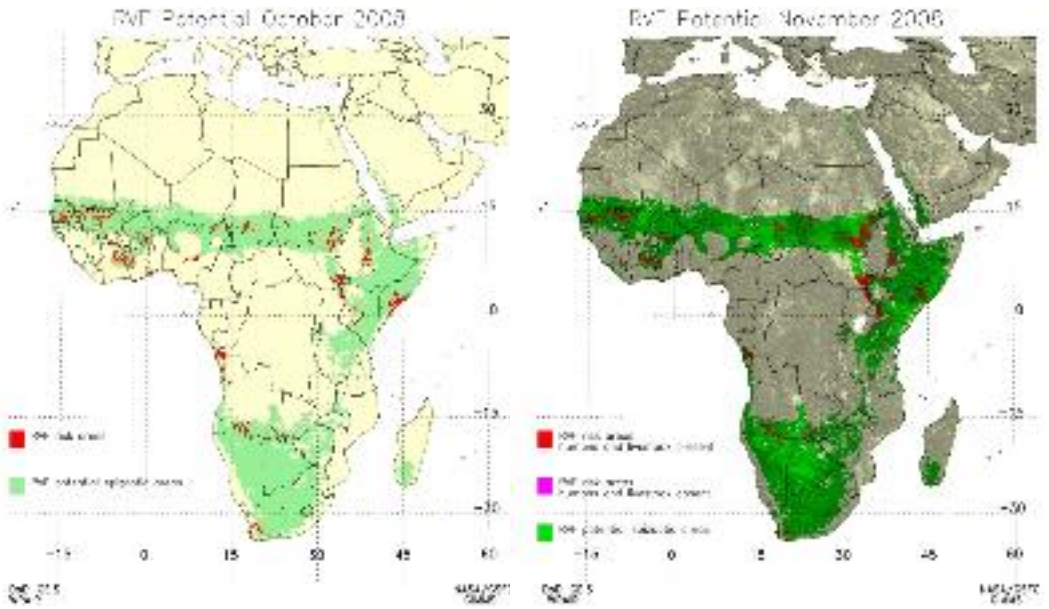
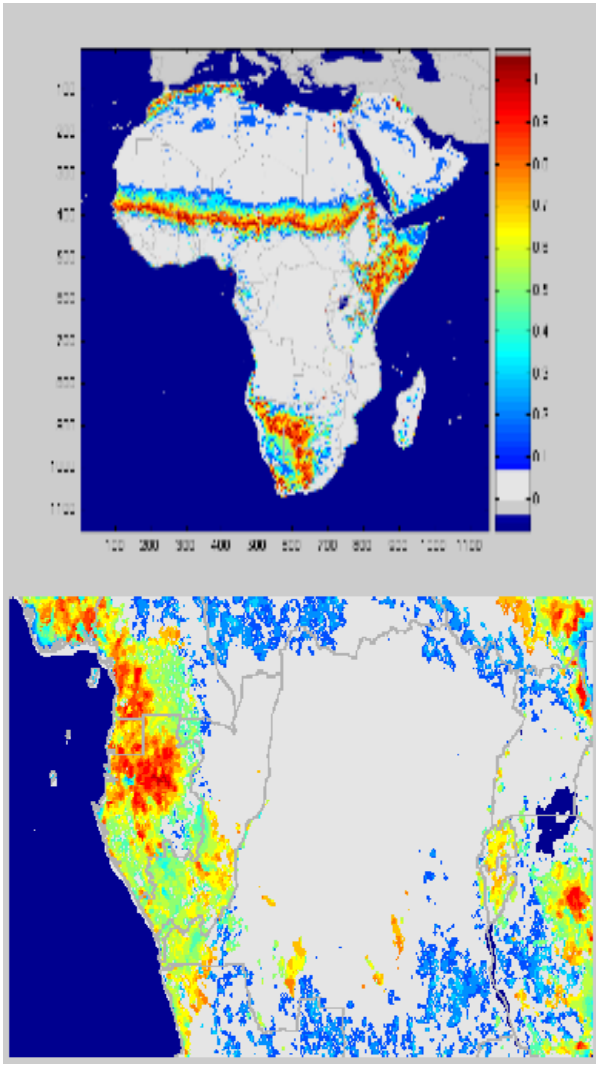
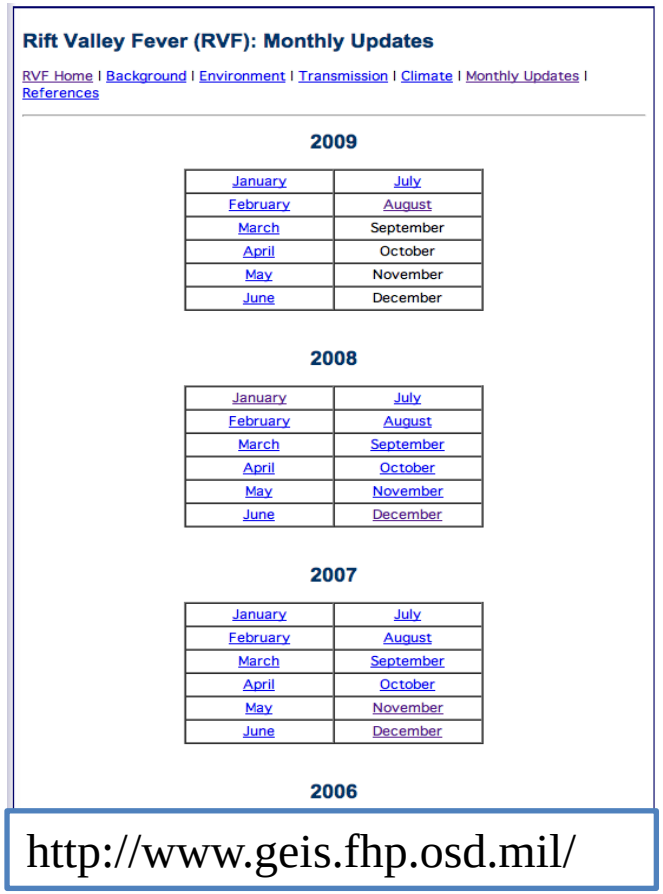
Endemic regions: RVF & Ebola





United States Department Of Agriculture
Agricultural Research Service

DoD-GEIS Web page



http://www.geis.fhp.osd.mil/

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Monthly Updates

http://www.geis.fhp.osd.mil/GEIS/SurveillanceActivities/RVFWeb/monthlypages/0908.htm

r (RVF): Monthly Updates

d | Environment | Transmission | Climate | Monthly Update

2009

January	July
February	August
March	September
April	October
May	November
June	December

2008

January	July
February	August
March	September
April	October
May	November
June	December

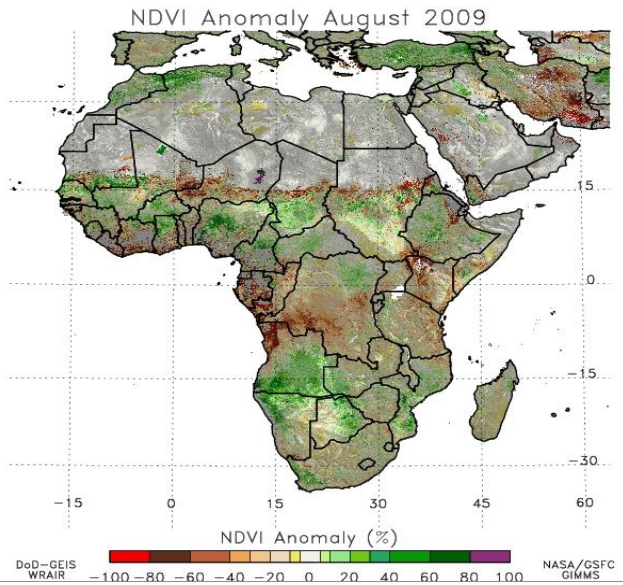
2007

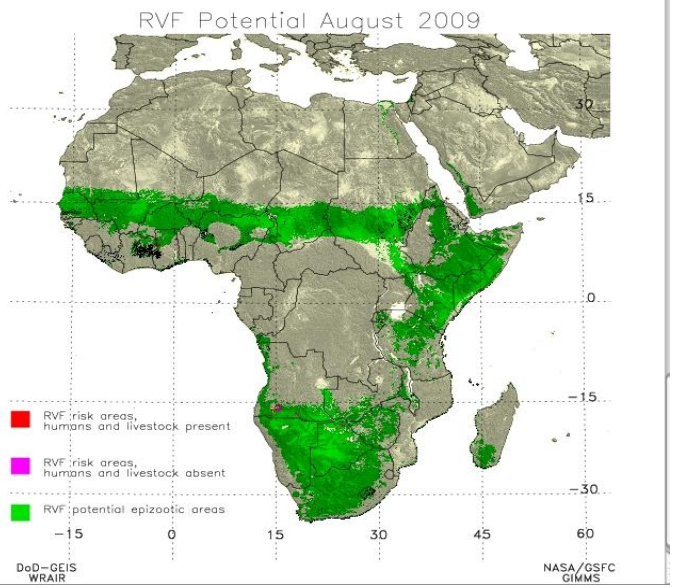
January	July
February	August
March	September
April	October
May	November
June	December

2006

January	July
February	August
March	September

NDVI anomalies for August 2009 show below normal NDVI eastern Sahel zone into East Africa and above normal NDVI over western Sahel zone and equatorial west Africa, in areas that have received above normal rainfall over the last 3 months. The RVF risk map below was derived from thresholding NDVI anomaly data. As previously shown by research, periods of widespread and prolonged heavy rainfall precede RVF outbreaks in endemic areas (Linthicum, 1983). Since vegetation as shown by NDVI time series positively responds to such rainfall events (Justice et al, 1986), especially in semiarid areas, we can use NDVI data as a measure of the magnitude and persistence of the anomalies associated with widespread and prolonged rainfall events. In the case shown below, for the period June to August 2009, we used the following steps to derive the RVF risk map. Compute the monthly NDVI anomalies (Month - Long-term Mean), for example shown for August 2009 below. Compute the average NDVI anomaly for the three months. Identify all pixels in the three month average anomaly image that exceed +0.1 NDVI anomaly threshold and also have positive anomalies in all three months. The derived map is a measure of the persistence of positive NDVI anomalies. Overall, for the period between June to August 2009 there were no areas that showed elevated RVF activity. On the below map, areas shown in green are those within the RVF endemic region (areas where RVF virus has been identified in the past). Areas shown in red, however, indicate areas at risk for RVF activity which coincide with locations having sufficient livestock and human presence to support an outbreak. The pink shows areas theoretically at risk for RVF activity but not having sufficient livestock and human presence to support an outbreak. Given the development of El Nino conditions and warmer than normal SSTs in the equatorial Indian Ocean, there is a high likelihood of above normal rainfall in the RVF endemic areas of East Africa between September and December 2009. Therefore the undertaking of preparedness and response measures should be considered undertaken in anticipation of a greater RVF outbreak risk. In addition the above normal rainfall in some areas of West Africa (Senegal and Mauritania) in the last two months requires enhanced surveillance in areas where RVF activity has occurred before.





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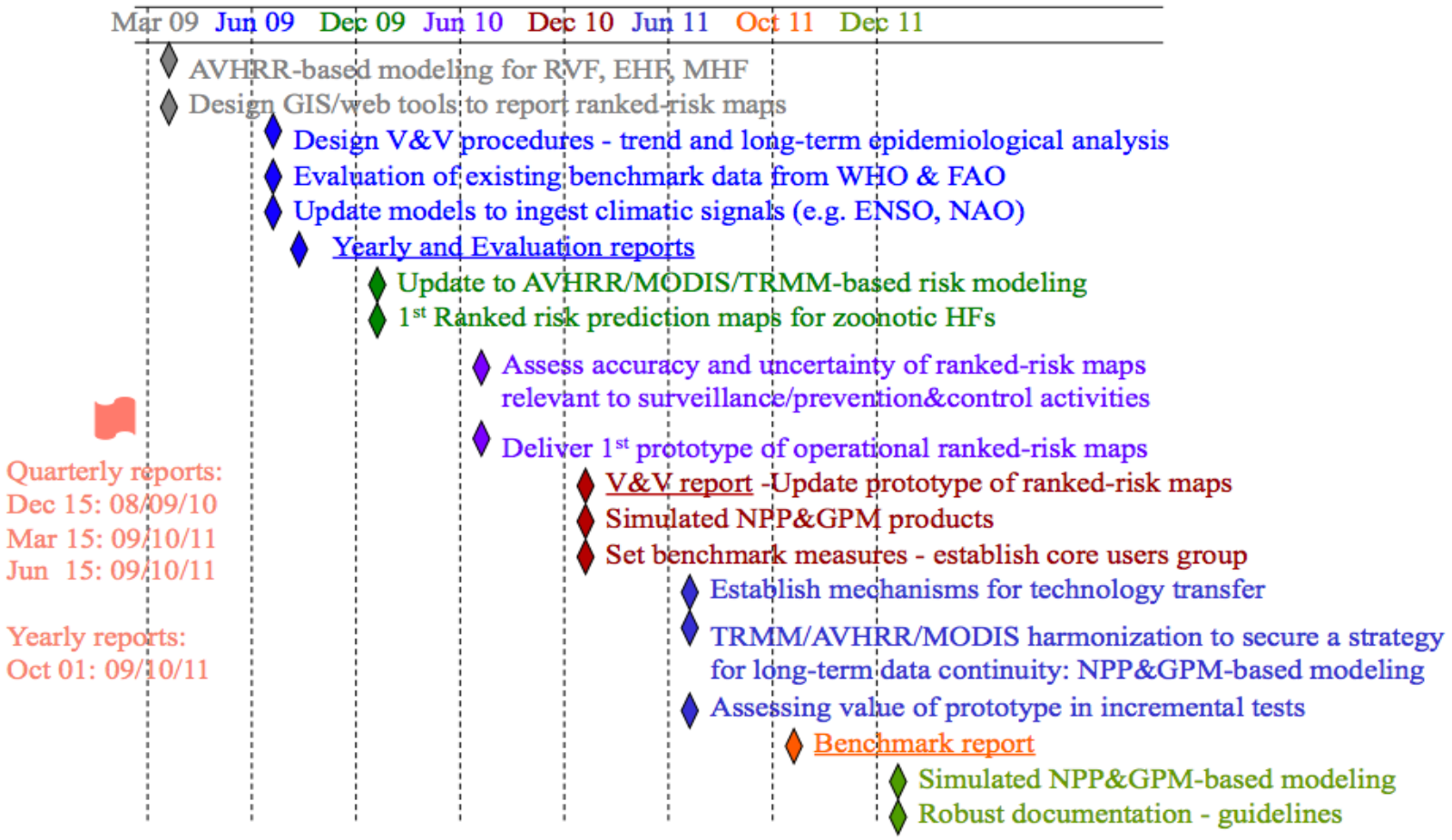
Zoonotic HFVs milestones



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Field Surveillance & Data Support

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- Rosemary Sang & KEMRI Field Team
- Robert Breiman, Allan Hightower CDC Team –Kenya
- Pierre Formenty, WHO
- Stephan De La Rocque, FAO
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Thank you!

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